More Profit from Nitrogen: understanding the role of N in mango production

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May 2017

DEPARTMENT OF **PRIMARY INDUSTRY AND RESOURCES**

AUSTRALIAN MANGOES

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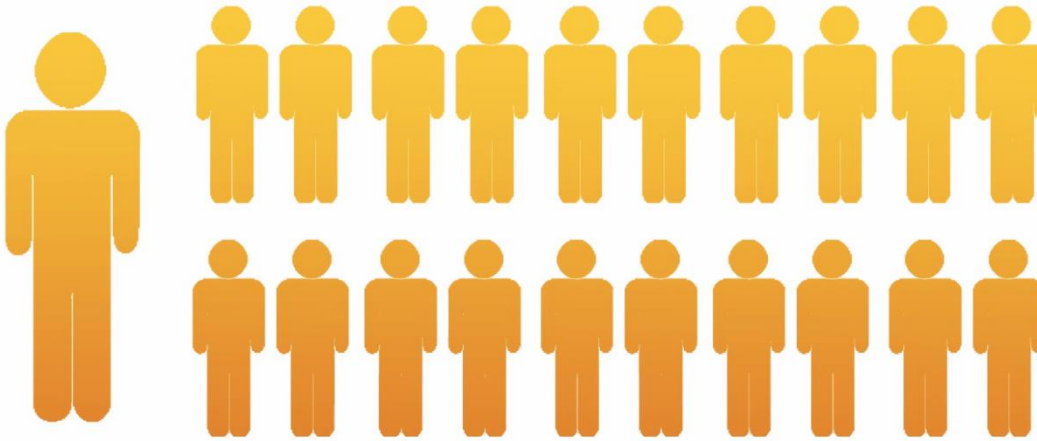
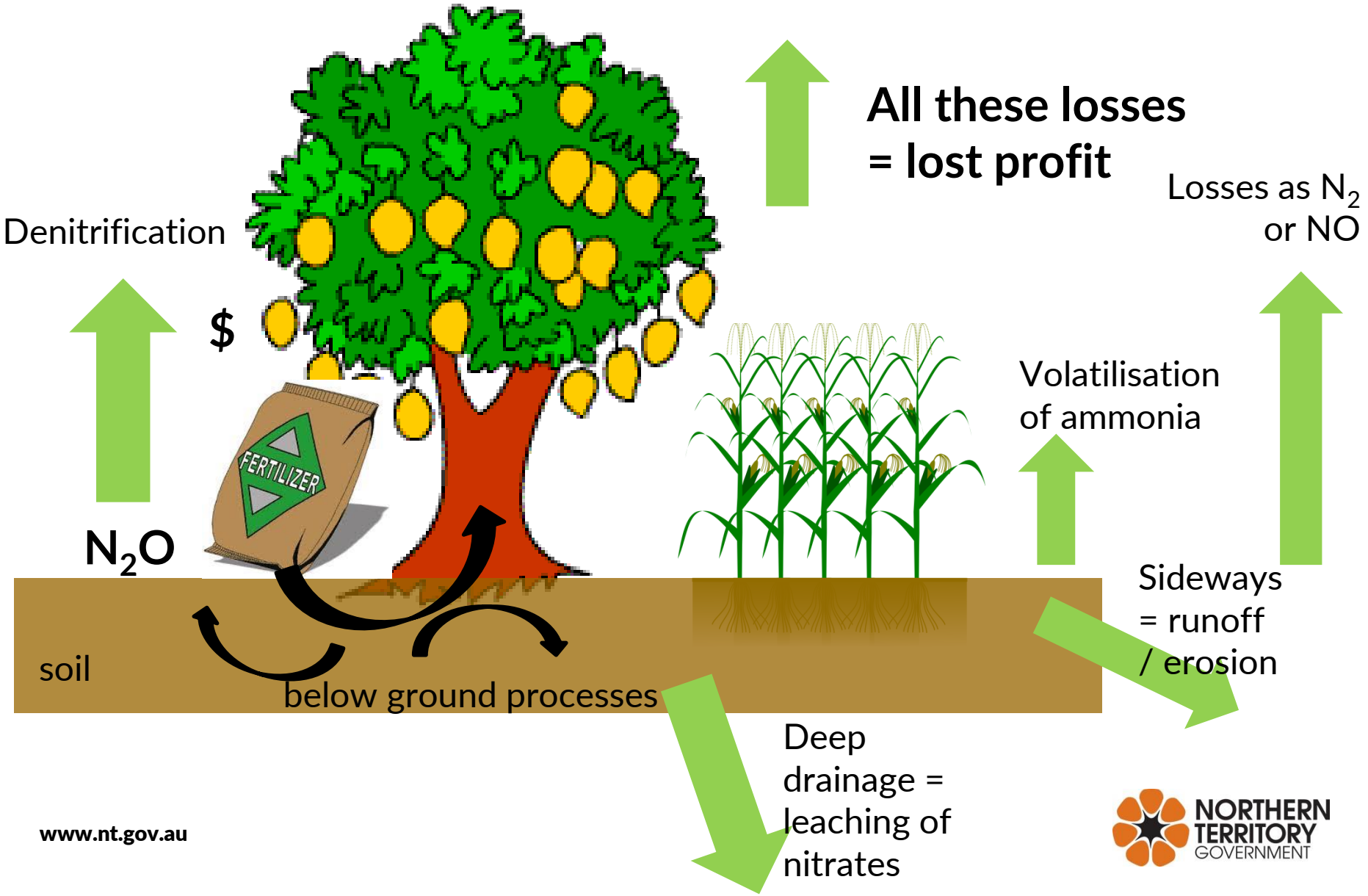
NORTHERN TERRITORY GOVERNMENT

Annual mango production in $mil since 1990

Employs 120 permanent staff and 2,500 casual staff



Nitrogen cycle in agriculture



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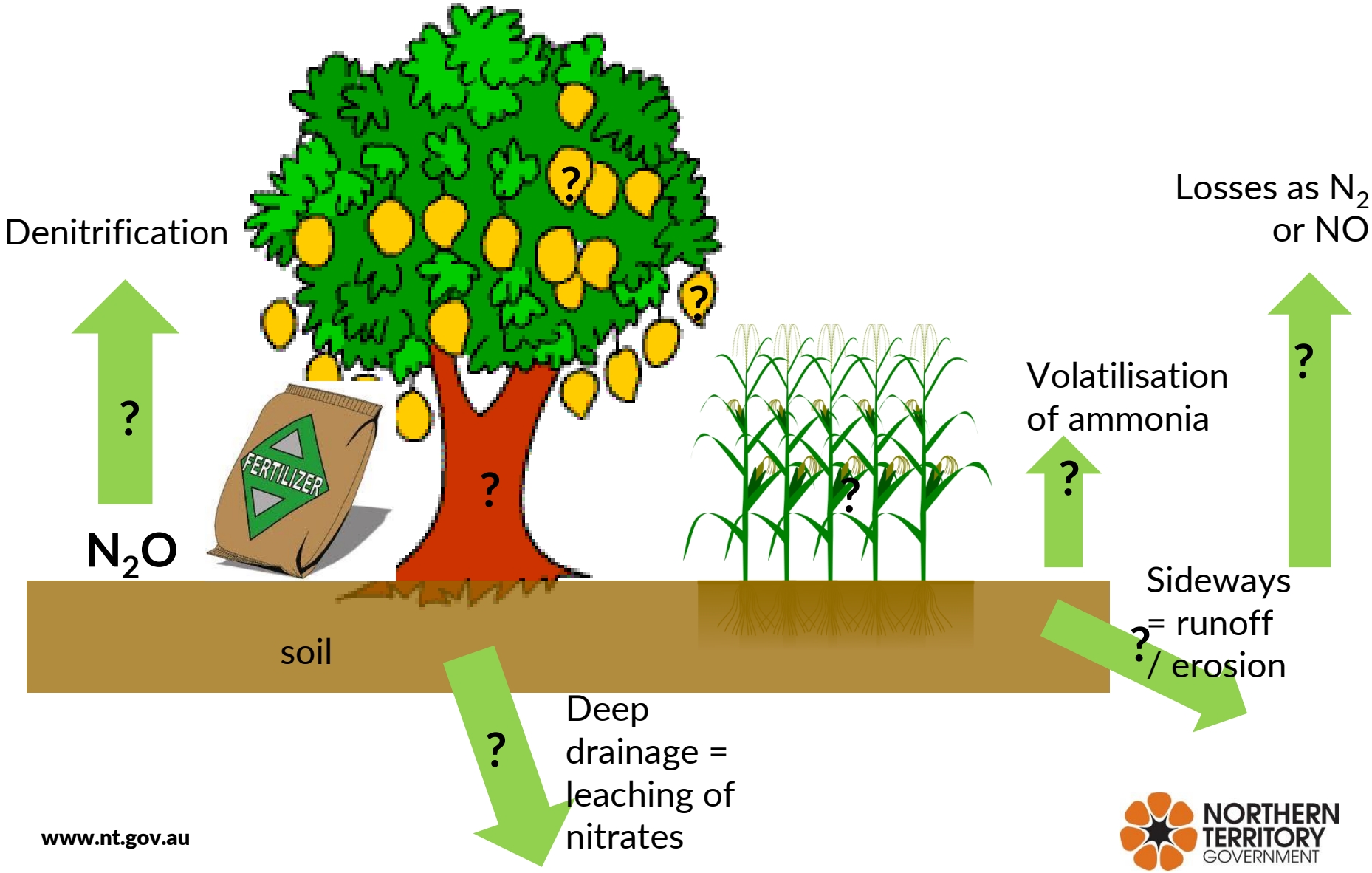
Where do losses occur, how big are they & what are the drivers?

- Deep drainage
  - Nitrate leaching –a one way ticket!
- Up = gas losses (can total > 50% of fertiliser N)
  - Volatilisation of ammonia (NH_3) - may be recovered but not necessarily on the same farm
  - Denitrification of nitrate (N_2O, NO, N_2) – again a one way ticket!
- Sideways = runoff / erosion
  - Urea, nitrate, ammonium, organic N (among other things!)

Where are the big losses in mangoes? Where can we improve efficiency of nitrogen fertilisers?



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- In the plant (**production**)?
- Within the plant, into the fruit (**profit**)?
- To the atmosphere (**loss**)?
- Stored in the soil (potential **loss**)?
- Or down the profile (**loss**)?

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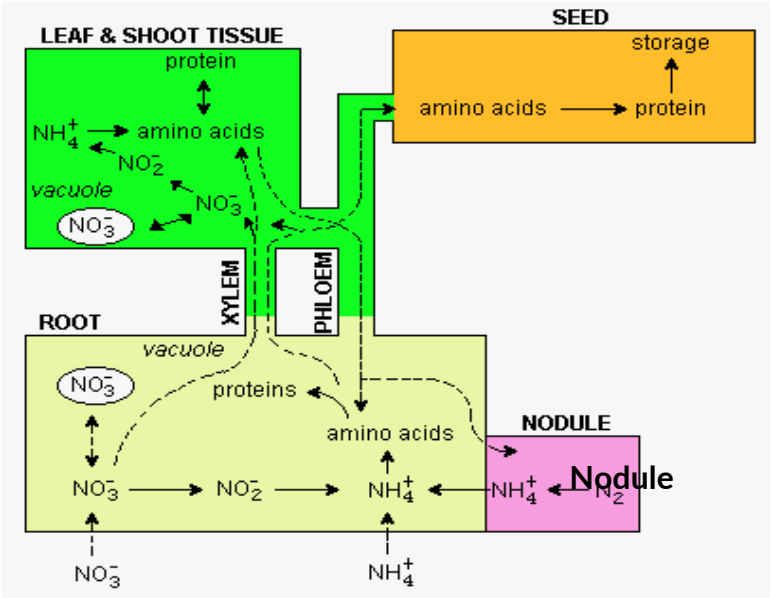
Nitrogen in mango

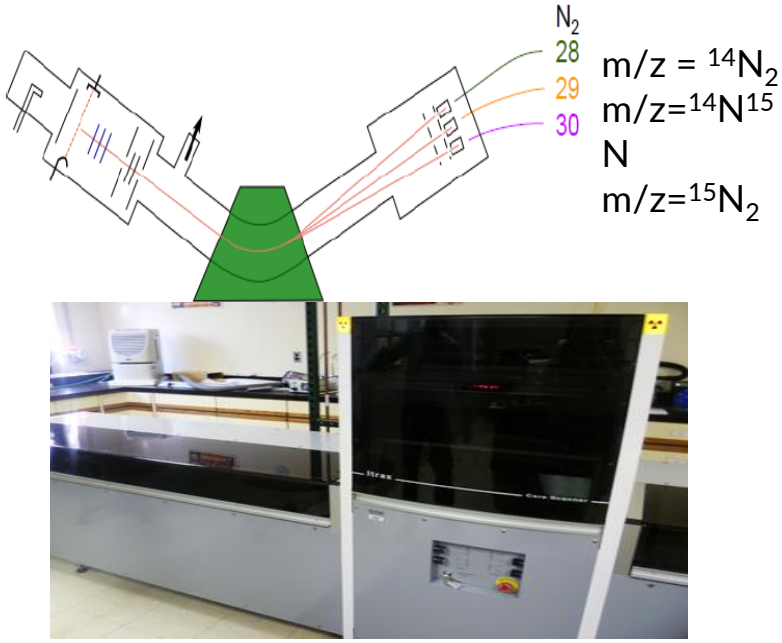
- Most important element for yield & quality
- Main nutrient that affects growth:
  - flush, flowers, fruit & roots
- Nitrogen in various forms has been shown to:
  - Increase tree vigour
  - Initiate flowering
  - Affects fruit quality, skin colour, disease, internal disorders, storage life

Stable isotope ^{15}N as a 'Tracer'

- Allow us to follow the fates and transformation of resources (fertiliser, water, pesticides etc.) in the plant
- The only direct means of measuring nutrient uptake from applied nutrient source



Chemically describe pathways and pools



Separation of N component from from labelled material using IRMS

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Labelled ^{15}N trials

- quantify the inter-annual dynamics of N through the different parts of the mango tree and soil profile including uptake, storage, and remobilisation
- to determine plant residue N contribution to mineralisation

Labelled ^{15}N trials

- Soil gas loss pathways will be measured with semi-automated chambers to collect ^{15}N-N_2O, CH_4 and CO_2 produced from the residues and comparison analysis undertaken with a zero residue treatments to determine nitrification, denitrification and decomposition rates in the soil.

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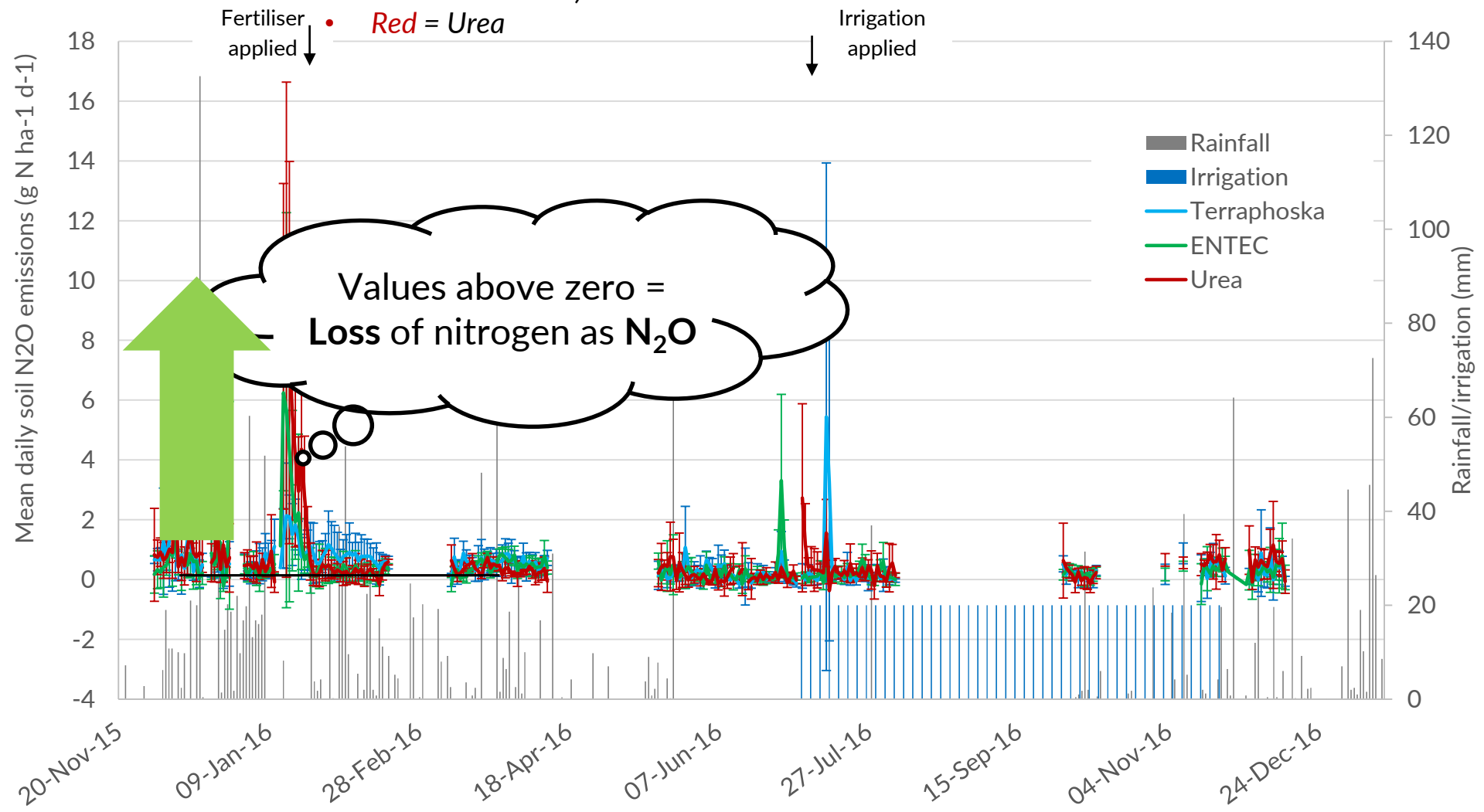
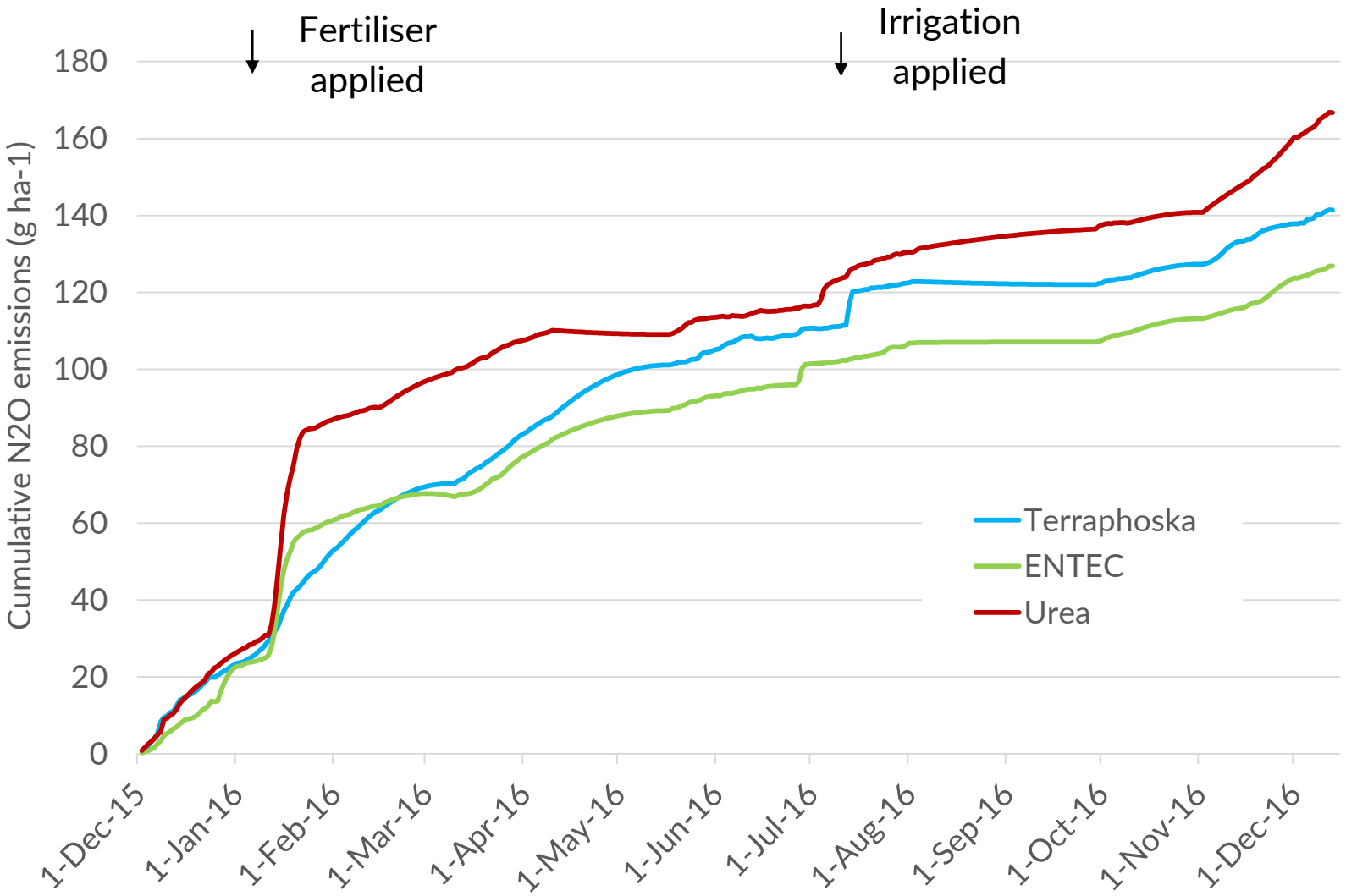
Soil nitrous oxide (N_2O) emissions from mango soils with different nitrogenous fertiliser forms, over 1 year, Darwin region

Same rate but 3 different forms of N:

- *Blue = farmer practice*
- *Green = Entec Urea (Incitec™: a DMPP ammonium stabilizer and nitrification inhibitor coated onto urea)*
- *Red = Urea*



Cumulative soil (N_2O) emissions from mango soils with different nitrogenous fertiliser forms, over 1 year, Darwin region



Understanding soils:
Field performance of EEFs and laboratory research

- Soils from mango orchards across Darwin and Katherine regions for incubation experiments will test the performance of a range of EEF's for these soils under controlled laboratory conditions

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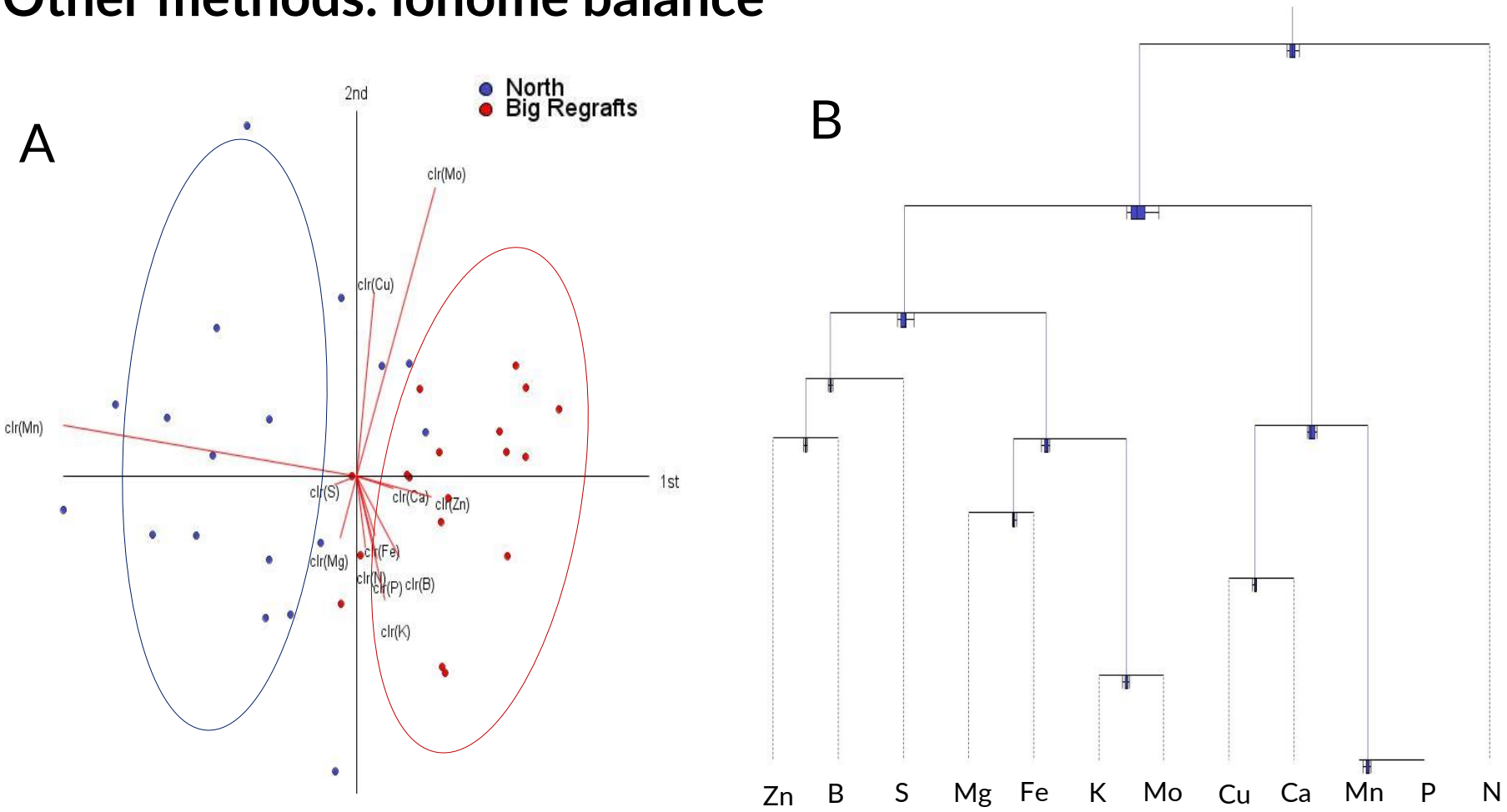
Other methods: ionome balance



Principal component analysis showing separation of leaf ionome between sites (A) and dendrogram showing imbalance of nutrient ratios (B).

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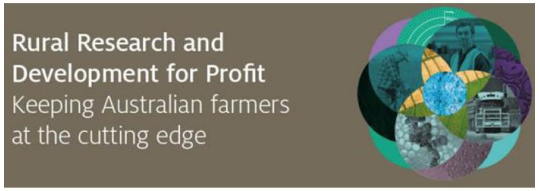
Other methods: remote sensing methods to measure tree health variability in mangos.



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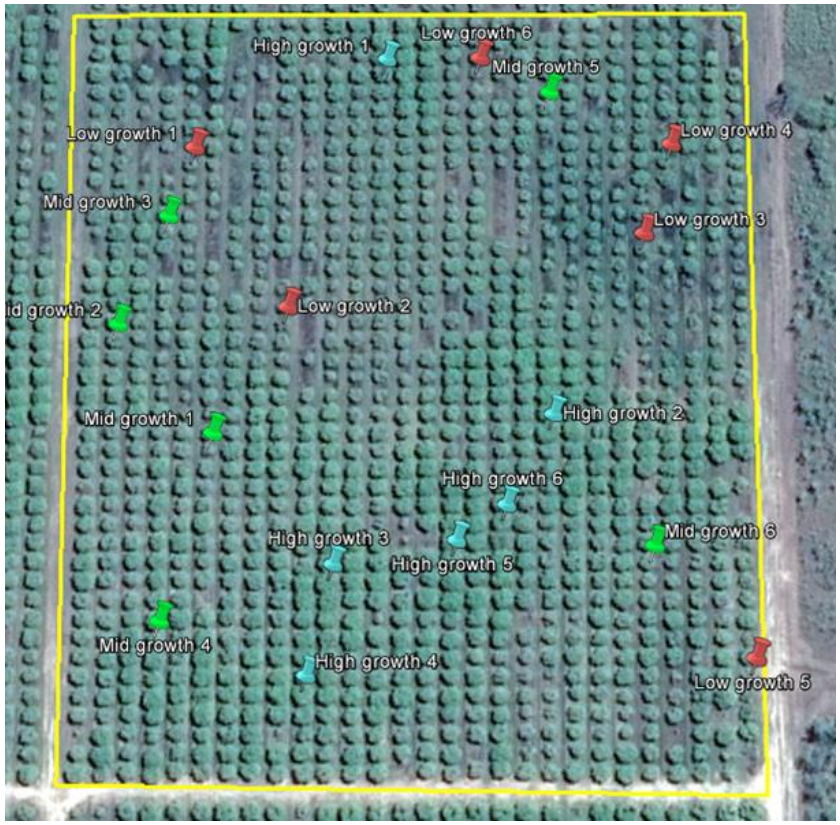
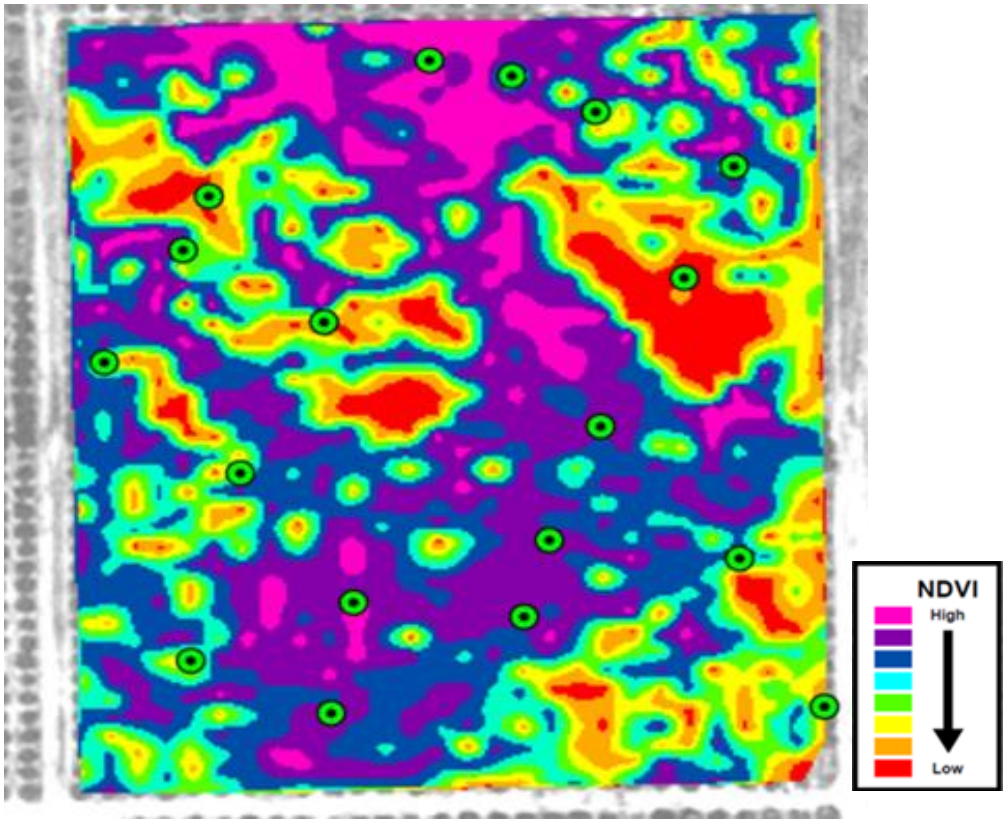


Worldview3 satellite image of NT Mango orchard. Individual tree sample locations indicated.



Classified NDVI map, the higher the NDVI value the more healthy/ vigorous the trees

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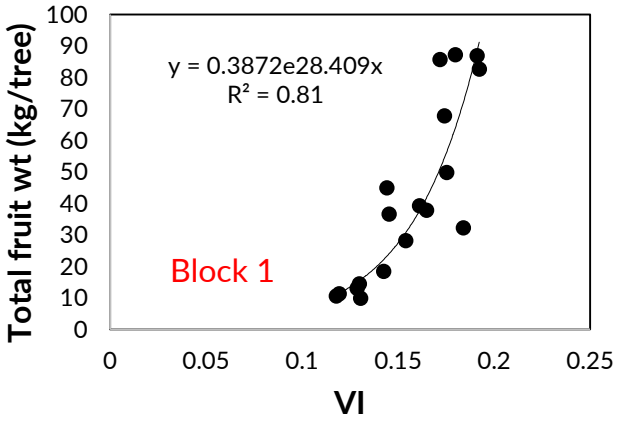
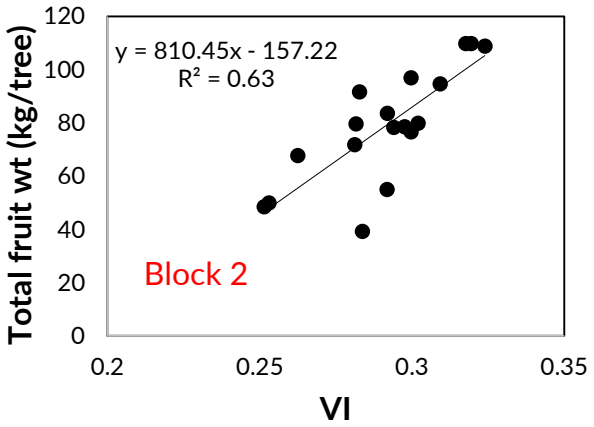
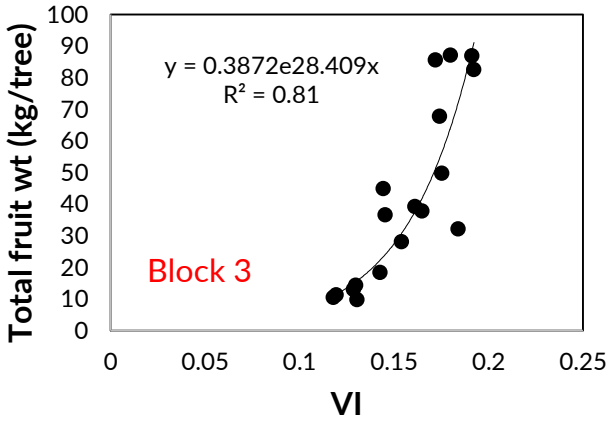
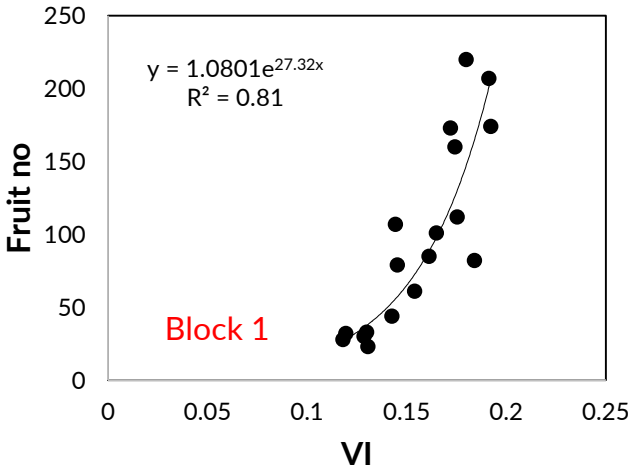
Vegetation Index (VI) vs Yield (Total Fruit Wt. per tree)

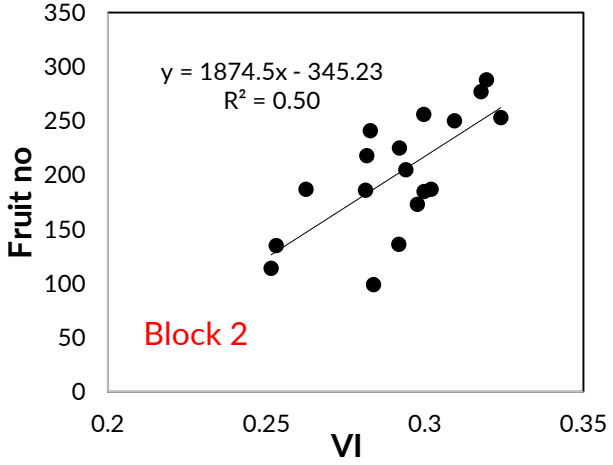


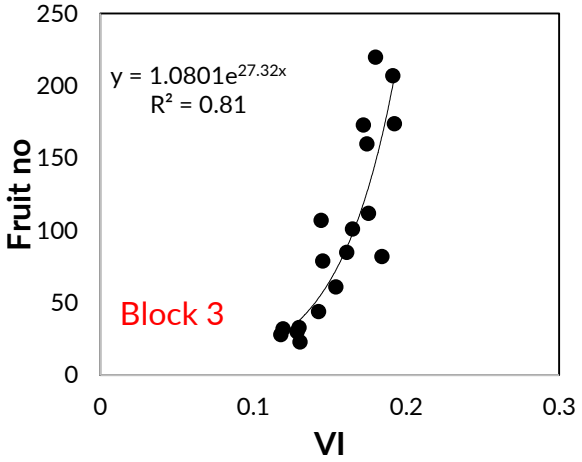




VI vs Total Fruit Number per tree







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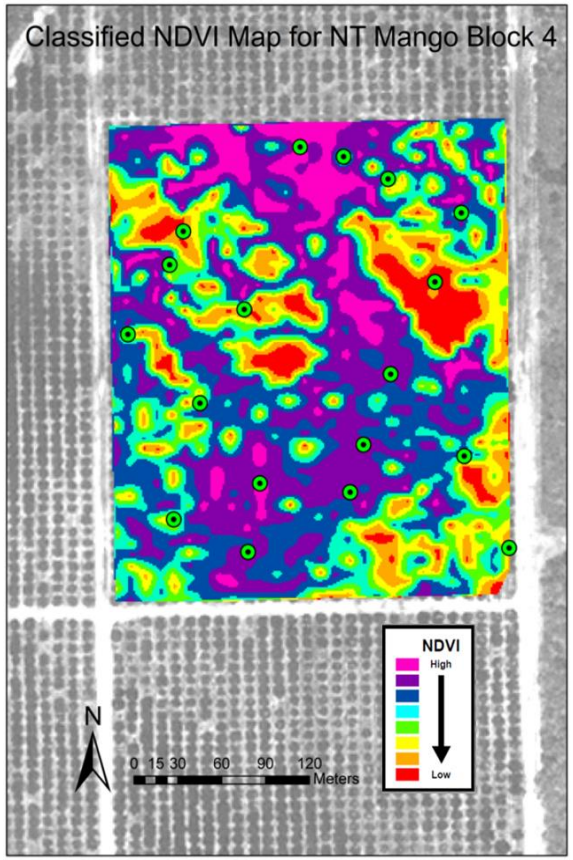
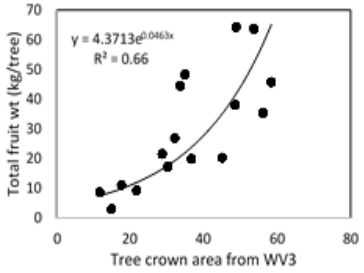
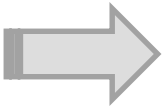
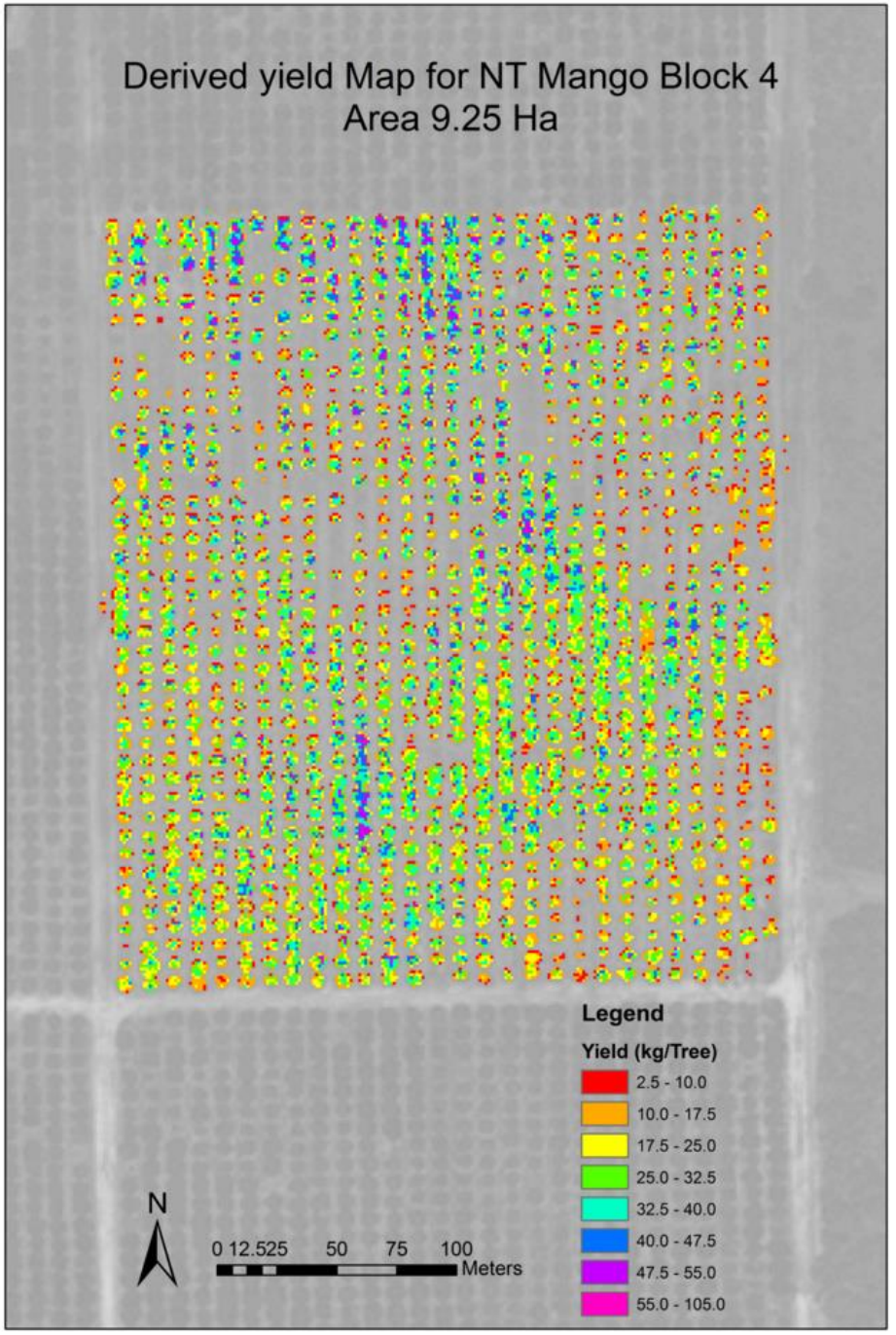
Derivation of Mango yield map.









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Big questions

- How can **N be managed most effectively** to make the most of available water and soil-N, to **maximise productivity** and **quality**, minimise losses to the environment and **provide economic benefits to the producer**?
- What **tools can producers use** to access better information regarding N dynamics and seasonal availability **to inform their decisions for a better economic outcome**?
- What is the **cost effectiveness of Enhanced Efficiency Fertilisers**, under a range of soil and climatic conditions, and product blends?
- Can we **develop better EEFs that release nitrogen based** on the demands of the crop?

Working with mango growers

- Sites in Darwin and Katherine regions
- With KP and hybrid varieties mangoes
- On range of soils and orchard ages

Output from this project will enable mango growers to optimise their use of N

- Understand how **novel N fertilisers impact mangoes** and **improve the synchrony of N supply with demand**
- Improve the **applicability and cost effectiveness** of N fertilisers in mango
- Prepare mango growers for **improved sensor technologies** that allow for **precision monitoring** of mango nutrition status

Thank you

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